PATENT SPECIFICATION

725,471

Date of Application and filing Complete Specification: April 28, 1953.

No. 11733/53.

Application made in United States of America on May 2, 1952.

Complete Specification Published: March 2, 1955.

Index at acceptance:—Classes 8(2), D3E2D: and 130, C1(A4: C1), M3I.

COMPLETE SPECIFICATION

Improvements in or relating to Respirator Filter Units for use in Cigarettes, Smoking Appliances, Gas Masks and the like

We, P. LORILLARD COMPANY, a corporation of the State of New Jersey, United States of America, of 119, West 40th Street, New York, United States of America and H & V SPECIALTIES CO. INC. a corporation of the Commonwealth of Massachusetts, United States of America, of East Walpole, Massachusetts, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to respirator filters, and has particular reference to filter units for tobacco products, such as cigarettes, and to methods and apparatus for making the same, although the invention is not limited thereto.

Numerous types of filters for cigarettes, smoking pipes, cigarette holders, gas masks, surgical respirators and other devices through which air is drawn by the user have been used or proposed, but in most instances, the cost of manufacture and the effectiveness of the filters leave much to be desired. Particularly in the case of tobacco smoke filters for cigarettes and the like, the effort has been to reduce the quantity of volatile materials, principally tar, entrained in the tobacco smoke. In order to be sufficiently effective to remove a substantial quantity of tar, the filter had to be made so dense as to increase the suction to an undesirable degree to draw the smoke through the filter and cigarette. Consequently, incomplete filters or filters having channels or passages were provided, with the result that the filter was ineffective to remove more than a small percentage of tar which was substantially only that which condensed on the surfaces through which the smoke was drawn.

Effective filtering material for removing predetermined quantities of tar and also nicotine from tobacco smoke drawn through a cigarette or other smoking article has been provided, one example comprising fibrous material, such as cotton, containing a predetermined uniform distribution of mineral particles having dimensions approaching those of the particles to be removed from the tobacco smoke, so as to cooperate with the cotton to remove a predetermined proportion of the said particles. Notwithstanding the pronounced effectiveness of this filtering material, its advantage in a cigarette filter unit still depends on uniform density throughout the cross-sectional area of the filter unit without any channels or other passages permitting the smoke to short-circuit the filtering material. The same requirements obtain for other filter units.

The present invention is designed to produce a respirator type of filter unit and a method and apparatus for making the same, whereby smoking apparatus or other respirator products embodying or containing the filter unit are uniform in density and "draw" to afford the same reduction in the quantity of entrained solid or liquid particles in the fluid passing therethrough, such as air containing tobacco smoke.

The method of making filter units, according to the invention, comprises longitudinally folding an elongated laminated strip formed of two or more layers of pervious fibrous material interleaved with one or more layers of substantially impervious sheet material into a trough of substantially J-shaped cross-section, circumferentially confining the trough-shaped strip to form a rope of substantially circular cross-section, wrapping the rope in sheet material to form a tubular

[Price 2s. 8d.] Price 4s 6d

cover therefor, and transversely severing the covered rope into cylindrical plugs for use as filter units.

A filter unit made by the method of the invention comprises a cylindrical plug formed of alternate layers of paper, preferably crepe paper, and cotton, in which the centre or core of the unit is provided by cotton-to-cotton contact.

The term "Cotton" as used herein means any suitable natural or synthetic textile fibres capable of being formed into a thin, pervious web, and the term "paper" as used herein means any suitable sheet material having the properties described herein and generally substantially impervious to the passage of gasses and vapours.

The novel filter unit preferably is made according to the method and with the apparatus of this invention so that equal numbers of layers of crepe paper and cotton are interleaved in such a way that the crepe paper layers, each supporting a cotton layer, are laid one upon the other and the sandwich thus formed is supported on the nethermost crepe paper layer so that the upper surface of the sandwich layer is a cotton layer. This sandwich-like sheet is fed to a plug-making machine, while carried on the nethermost layer of crepe paper, but just before entering the machine, the nethermost layer of crepe paper is stripped therefrom, so that the upper and lower layers of the sheet are cotton. Narrow strips are severed transversely from this composite sheet and fed endwise to a conical forming die, but before reaching the die, the strip is creased off-centre lengthwise, so as to then fold unevenly upon itself in the conical forming die, i.e., because of the off-centre crease, one leg of the infolded strip is wider than the other, so that the edges thereof do not register. When rolled into generally J-shaped contour in the forming die, the non-registering edges of the strip do not leave a passage at the core and, with the aid of cotton-to-cotton contact at that point, the resulting plug is of uniform cross-sectional density. The rope-like strip is then wrapped in paper and severed into shorter lengths, which are then incorporated in a cigarette, used as a cartridge for smoking pipes, cigarette holders or other smoking articles, or as cartridges for gas masks, surgical respirators, and the like.

It will be seen that the filter unit and the method and apparatus of making the same provide a filter unit of uniform density and "draw", notwithstanding the numbers that may be manufactured.

In order that the invention may be clearly understood and readily carried into effect, apparatus for making filter units according to the invention will now be more fully described, by way of example only, with reference to the accompanying drawings, in which:—

Figure 1 is an elevation of apparatus for laminating three sets of paper overlaid with a web of fibrous material, such as cotton.

Figure 2 is a transversed section as seen along the line 2—2 of Figure 1, showing the laminate formed in Figure 1, and comprising three alternate layers of paper and cotton with the entire sandwich-like laminate supported on the lowermost paper layer.

Figure 3 is an elevation of the mechanism for feeding the laminate or sandwich of three alternate layers each of cotton and paper through successive processing stages and showing edge-trimming mechanism, intermittent feeding mechanism, mechanism for stripping the lowermost sheet of paper from the sandwich or laminate, and mechanism for severing the sheet transversely into long, narrow strips.

Figure 4 is a schematic plan view of the mechanism of Figure 3 with the addition of conical forming mechanism for shaping the long, narrow strips into a rope-like shape, wrapping the same and severing it into filter units.

Figure 5 illustrates the conical forming die of Figure 4 as it appears on a commercial machine as modified to embody the present invention.

Figure 6 is an elevation thereof as seen along the line 6—6 of Figure 5.

Figure 7 is a transverse section through a strip creasing roll and a carrier tape for the strip as seen along the line 7—7 of Figure 6 and showing the off-centre relation between the creasing roll and the laminated strip.

Figure 8 is a transverse section through the forming die as seen along the line 8—8 of Figure 6.

Figure 9 is a transverse section through a grooved pressing roller constituting part of the forming mechanism as seen along the line 9—9 of Figure 6.

Figures 10A, 10B and 10C are cross-sections through the laminated strip in successive stages of its formation into the rope, and shows the convolutions of alternate layers of paper and cotton and the result of the cotton-to-cotton contact at the centre or core without channels and the off-centre creasing of the strip preceding its entry into the conical forming die, and

Figure 11 illustrates in perspective view a stationary type of strip creasing or folding device.

Referring to Figures 1 and 2 of the drawings, the cotton or other fibrous material C with or without admixture of the mineral particles as referred to above, is laid uniformly as a thin but continuous web upon a sheet of paper such as crepe paper P whose creases or crepe folds extend transversely thereof. The cotton web may be conveniently supplied by a commercial carding machine in a width somewhat narrower than the width of the crepe paper sheet P, so that about half inch margin of paper extends beyond the lateral edges of the cotton web C, as shown in Figure 2.

In the preferred filter unit of this invention three layers of cotton and three layers of paper comprise the starting laminate or sandwich S and are initially interleaved from three primary supply rolls 10, 11 and 12, the rolls 11 and 12 each comprising one long sheet of crepe paper P overlaid by one layer of cotton C, and the roll 10 comprising one long sheet of strong paper P^1, such as kraft paper, overlaid by one layer of cotton C. The layer P^1 also may be crepe paper if desired.

The three primary supply rolls 10, 11 and 12 are simultaneously unrolled with the unrolled portions of each overlaying the unrolled portion of the others in the manner shown in Figure 1, so as to form the laminate or sandwich S comprising three layers each comprising one layer of paper and one of cotton, with the nethermost layer being paper and the topmost layer being cotton, as is shown especially in Figure 2.

The primary supply rolls 10, 11 and 12 are mounted on mandrels journalled in a suitable frame, not shown. A driven endless belt conveyor 13 may support the laminate or sandwich S and may drive it and thus unroll the rolls 10, 11 and 12 by frictional contact therewith, with the laminate or sandwich S. In this way, the separate two-layer strips are unrolled from the primary supply rolls 10, 11 and 12 upon a main supply roll 14 in step with each other and the roll 14, so that the cotton C and the paper P are not materially strained or stretched. The main supply roll 14 may be driven if required.

The main supply roll 14 is transferred from storage or from the machine of Figure 1 to the machine of Figure 3 for unrolling onto a table 15 thereof. Alternatively, the laminate or sandwich S may be fed by the conveyor 13 directly to the horizontal table 15 of Figure 3. Assuming the transfer of the storage roll 14 to the machine of Figure 3, the former is unwound flatwise on the table 15 in any suitable way, as by driving its mandrel from an intermittent drive mechanism including a source of power such as the electric motor 16 shown in Figure 3, whereby the feed of the laminate or sandwich S is synchronised with the intermittent plug-making machine to be described. The unwinding of the roll 14 is so regulated as to maintain a uniform linear rate of movement of the sandwich or laminate S over the table 15.

As the laminate or sandwich S is advanced over the table 15, the margins of crepe paper extending beyond the lateral edges of the three webs of cotton C are trimmed off in any suitable manner as, for example, by rotating knives 17, driven by a belt or chain 18 from the mandrel of the roll 14, in the manner shown in Figures 3 and 4, or in any other convenient manner. Accordingly, the sandwich or laminate S comprises alternate layers of paper P and cotton C of uniform width. The edge-trimmed sandwich S is engaged by a driving roll 19, driven by a chain or belt 20, which aids in drawing the sandwich S through the edge-trimming knives 17 and in advancing the sandwich S along the table 15, this driving roll being positioned just beyond the edge-trimming knives 17 as shown in Figures 3 and 4.

Positioned just beyond the driving roll 19 and located in a slot in the table 15, is an idler roll 21 over which the nethermost layer P^1 of paper moves downwardly and is thus separated from the lower cotton layer which now takes the place of the separated paper layer P^1 by which the sandwich S was theretofore supported on the table 15. The separated paper layer P^1 is drawn onto a take-up roll 22 suitably driven by a belt or chain 23 at the proper peripheral speed to obtain uniform movement of the sandwich S across the table 15 and the take-up roll 22 aids in that movement. Thereupon the sandwich or laminate S comprises two layers of paper P and three layers of cotton C with the upper, lower and centre layers being cotton interleaved by the two remaining layers of paper.

From this point, the five-layer sandwich or laminate S resting on a transverse platform 24 is advanced intermittently by reciprocating pushers 25 actuated by an oscillating shaft 26. The pushers 25 shown in Figure 3, advance the five-layer laminate sandwich S beneath a reciprocating knife 27 which serves it transversely into narrow strips 28 which may be substantially 1½ inches in width and 26 inches in length, for example. The severed strips 28 lodge in a channel 29 in which they are advanced

endwise to a belt type conveyor shown in Figure 6, and comprising an endless belt 30 running over a pair of rollers 31 journalled in a horizontal plane so as to provide a horizontal conveying surface between them. The belt 30 also passes over a series of rollers 32, one of which is driven to drive the upper run of the belt 30 in the proper direction from right to left, as seen in Figure 6.

Positioned above the right-hand or infeed end of the belt 30 as seen in Figure 6, is a feed roller 32^1 which is driven in the direction of movement and peripheral speed by and in accordance with the linear speed of the belt 30 and presses the laminated strip 28 against the belt 30 for advancement thereby to the left, as seen in Figure 6.

Immediately following the feed roller 32^1 and also driven by the belt 30 through the laminated strip 28 is an off-centre creasing or folding roller 33, whose centre line is displaced laterally with respect to the longitudinal centre line of the laminate strip 28 by approximately $\frac{1}{4}$ inch, as is shown particularly in Figures 3 and 7. By reason of its off-centre position with respect to the strip 28, the rounded periphery of the folding or creasing roller 33 folds or creases the strip 28 unevenly, lengthwise, i.e., the left-hand portion of the strip 28 as seen in cross-section in Figures 7, 8 and 10A, is wider than is the right-hand portion thereof. Hence, as the edges of the strip 28 rise in response to the folding and creasing action of the roller 33, the left-hand edge rises higher than the right-hand edge so that the strip 28 has the uneven trough-shaped cross-section shown in Figures 7 and 10A. Thus if the said left-hand and right-hand portions of the strip 28 are folded flatwise upon each other, the longitudinal edges would not be in registry as is shown in Figure 10B.

Positioned at each side of the roller 33 are channel-shaped guides 34 which are upturned to accommodate and aid tendency of the edges of the strip 28 to turn upwardly in the manner described. To compensate for the longer left-hand side of the strip, the left-hand guide 34 is longer and extends further from the centre line of the feed belt 30 as is likewise shown in Figure 7. Conversely, the right-hand guide 34 is shorter and lies somewhat more closely to the centre line of the belt 30 to accommodate the shorter half of the strip 28 as seen in cross-section.

As the feed belt 30 carries the strip 28 through the guides 34, it enters a conical forming die 35 at a time when the longitudinal edges of the strip 28 have been lifted to shape it into a reversed J-shaped cross-section with the left-hand leg thereof longer than the right-hand leg thereof for the reasons mentioned. Accordingly, as the J-folded laminated strip 28 enters the conical forming die 35, which is a continuation of the guides 34, the off-set edges are curled downwardly upon one side of the centre portion which then takes the convoluted shape shown in Figure 10C.

As the folded strip 28 advances between rollers 36 and 37 which have concave peripheral surfaces, the belt 30 is warped into a U-shape to aid in circumferentially confining the strip 28 into the rope-like contour 28^1 shown in Figure 9. Accordingly, the strip 28 is confined circumferentially into a generally circular cross-section with cotton-to-cotton contact between the original cotton upper surface and the original cotton lower surface of the strip 28 and between the same cotton surface folded upon each other, thereby precluding or closing all passages which tend to form, and aided by the misalignment of the edges of the strip 28 so that uniform density results.

The rope emerging from between guides 38 is delivered immediately to a wrapping station where a strip 39 of cigarette paper, for example, is concurrently fed from a reel 40 shown in Figure 4 and wherein the rope 28^1 is wrapped and the seam heat-sealed with flue or cement at 41.

The successive strips 28 are aligned end-to-end as they are shaped into the circular cross-section shown in Figures 9 and 10C, and are wrapped in the paper from the reel 40 so that a continuous wrapped rod 42 emerges from the machine to be severed into approximate $2\frac{4}{5}$ inch lengths 43 by a flying knife 44. The cylindrical lengths 43 which have the transverse joint formed at the juncture of successive strips are culled out by removal of every tenth length, and the remaining lengths are then sub-divided into shorter lengths, and may be incorporated in the end of a cigarette in a cigarette-making machine to become part of the cigarette.

The off-centre folding or creasing of the strip 28 to achieve the uneven folding of the edges upon each other may be effected by other means than the roller shown in Figure 7. For example, a stationary vertical blade 33^1 shown in Figure 11 will perform the folding function of the roller 33 or other equivalent mechanism.

In its passage through the conical forming die 35, the trough-shaped but unevenly-folded strip 28 assumes convolutions which delineate a shape somewhat like a pear with the narrow end continued into a curve, and close variants

thereof. In any event, the cotton-to-cotton contact together with the misalignment of the longitudinal edges preclude the formation of channels or passages through which the smoke or other gaseous material may short-circuit the filter material and thus remain untreated.

Although the off-centre folding of the laminate strip to misalign the opposite edges thereof upon formation into a rope is preferred, folding of the strip along its centre line into U-shaped cross-section still provides filter units which are satisfactory for many purposes, because of the cotton-to-cotton contact afforded by the greater number of cotton layers as compared to the one less number of paper layers, e.g., two-to-one, respectively, to more than three-to-two, respectively, e.g., five-to-four, respectively, depending upon requirements.

Similar mechanisms may be provided for forming filter units of different dimensions according to the method of this invention for use as gas mask or as surgical respirator filter cartridges and the like, as well as filter cartridges for cigarette holders, smoking pipes, and the like.

What we claim is:—

1. The method of making respirator filter units, which comprises longitudinally folding an elongated laminated strip formed of two or more layers of pervious fibrous material interleaved with one or more layers of substantially impervious sheet material into a trough of substantially J-shaped cross-section, circumferentially confining the trough-shaped strip to form a rope of substantially circular cross-section, wrapping the rope in sheet material to form a tubular cover therefor, and transversely severing the covered rope into cylindrical plugs for use as filter units.

2. The method according to claim 1, in which the longitudinal edges of the strip are lapped in fibrous material contact before the strip is formed into a rope.

3. The method according to claim 1 or claim 2, in which the longitudinal edges of the strip are lapped unevenly in fibrous material contact before the strip is formed into a rope.

4. The method according to claim 1 or claim 2, in which the longitudinal edges of the strip are lapped unevenly and then the extending edge lapped over the other edge of the strip before the strip is formed into a rope.

5. The method according to any one of the preceding claims, in which the layers of fibrous material are three in number and the interleaved layers of substantially impervious material are two in number.

6. The method according to any one of the preceding claims, in which the laminated strip is conveyed on a supporting strip, the said supporting strip being removed from the laminate in advance of the strip folding point.

7. Apparatus for performing the method of any one of claims 1 to 6, comprising mechanism for feeding a strip of interleaved layers of material to a folding mechanism, mechanisms for confining the folded or trough shaped material into a substantially circular section rope, and for wrapping the rope in sheet material, and cutting mechanism for transversely shearing the covered rope into cylindrical plugs.

8. Apparatus according to claim 7, in which the folding mechanism comprises a creasing roller or a shoe spaced laterally from the longitudinal centre line of the said strip.

9. A filter unit manufactured according to the method of any one of claims 1 to 6.

10. A filter unit manufactured by the apparatus of claim 7 or claim 8.

11. Apparatus according to claim 7, having its parts constructed and arranged substantially as described with reference to Figures 1 to 9, or as modified by Figure 11, of the accompanying drawings.

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Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press.—1955.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

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3 SHEETS
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SHEET 1

FIG. 10A. FIG. 10B. FIG. 10C.

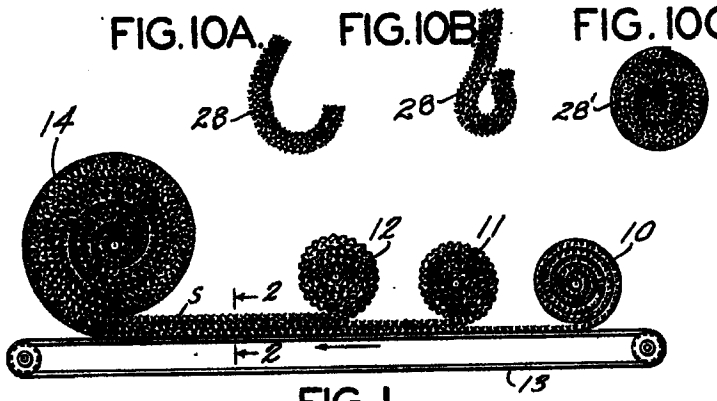

FIG. 1.

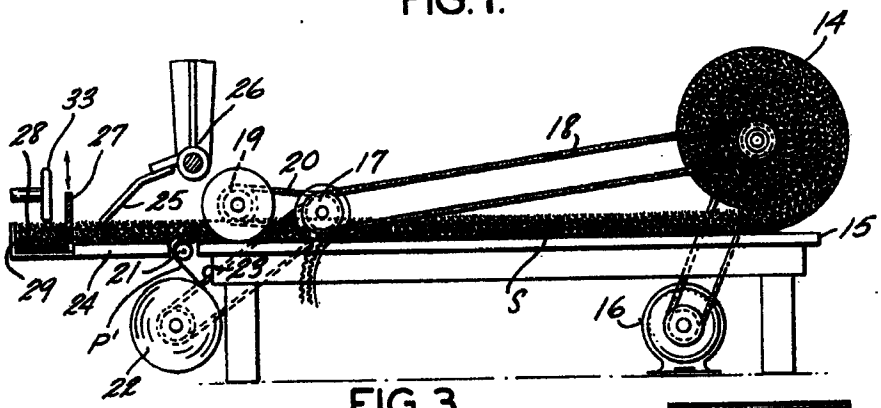

FIG. 3.

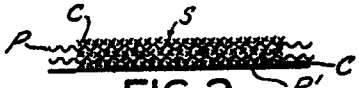

FIG. 2.

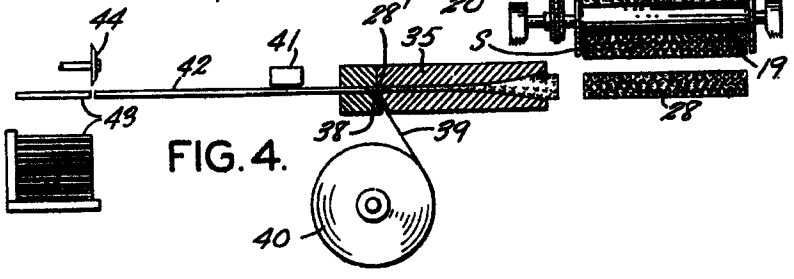

FIG. 4.

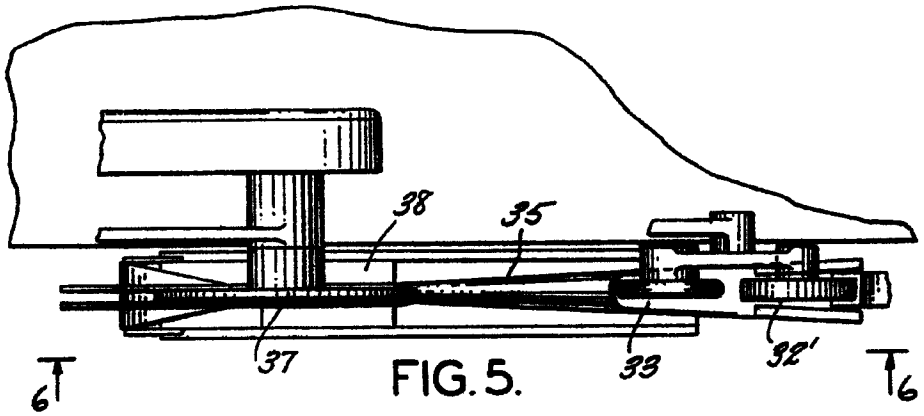

FIG. 5.

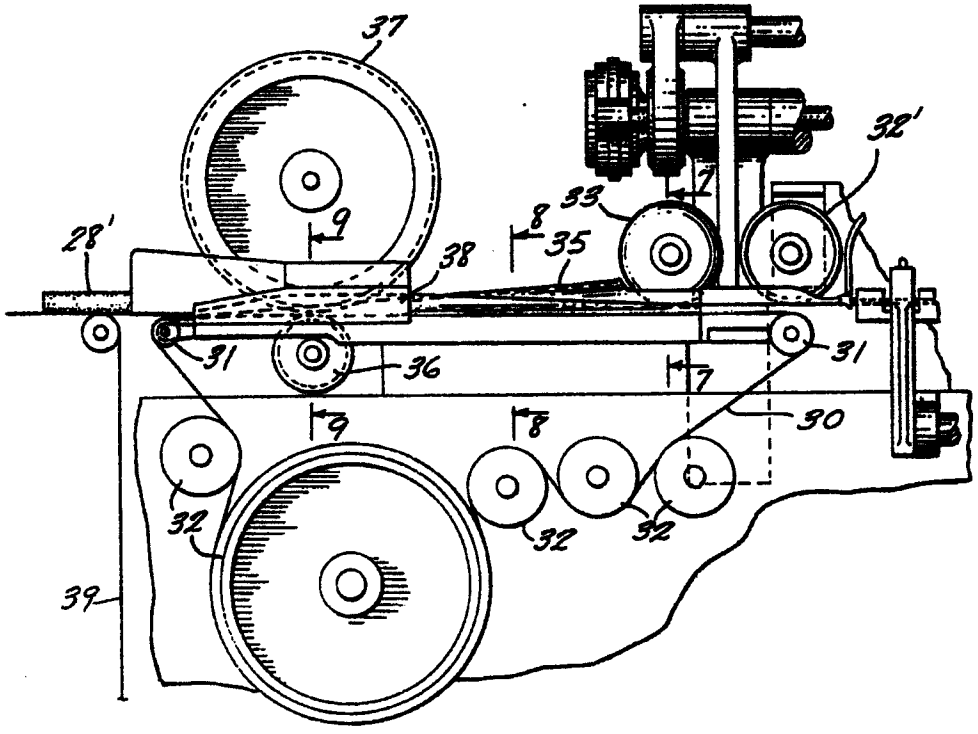

FIG. 6.

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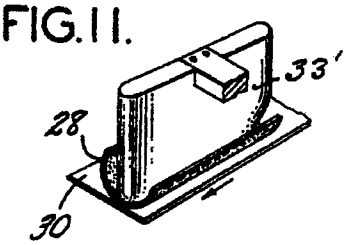
SHEETS 2 & 3

FIG. 11.



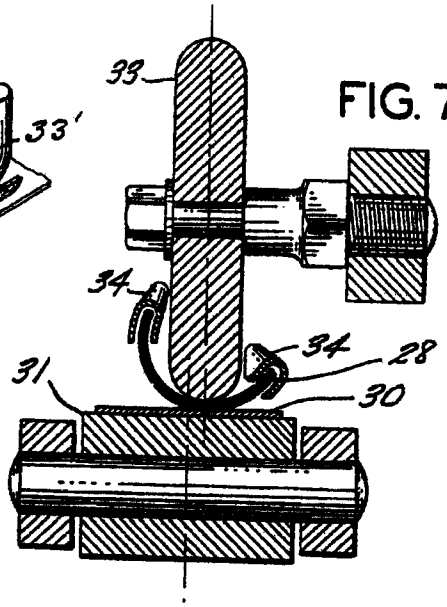


FIG. 7.

32'

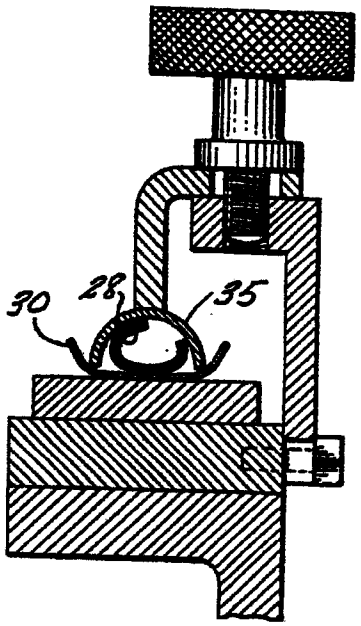


FIG. 8.

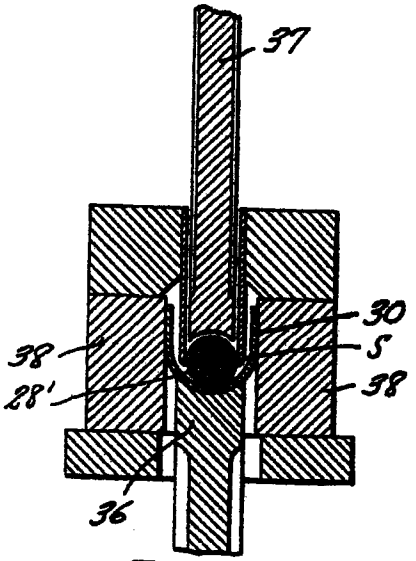


FIG. 9.

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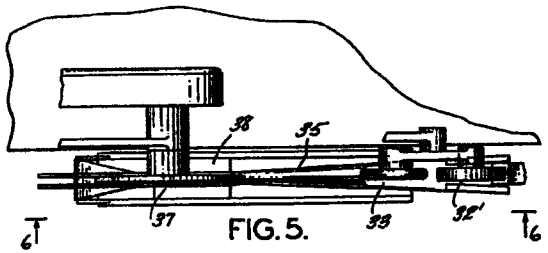


FIG. 5.

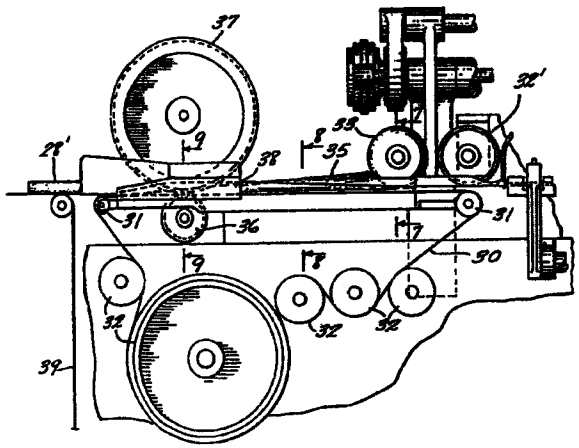


FIG. 6.

FIG. 11.

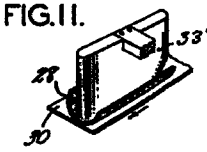
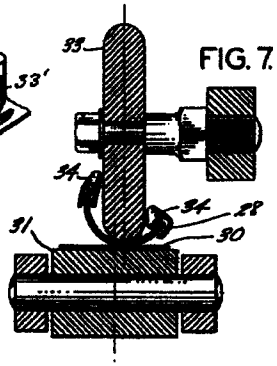


FIG. 7.



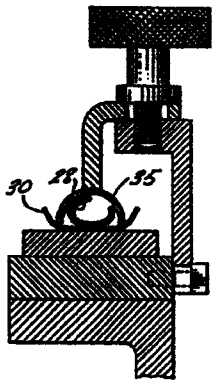


FIG. 8.

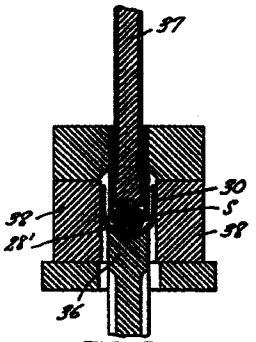


FIG. 9.